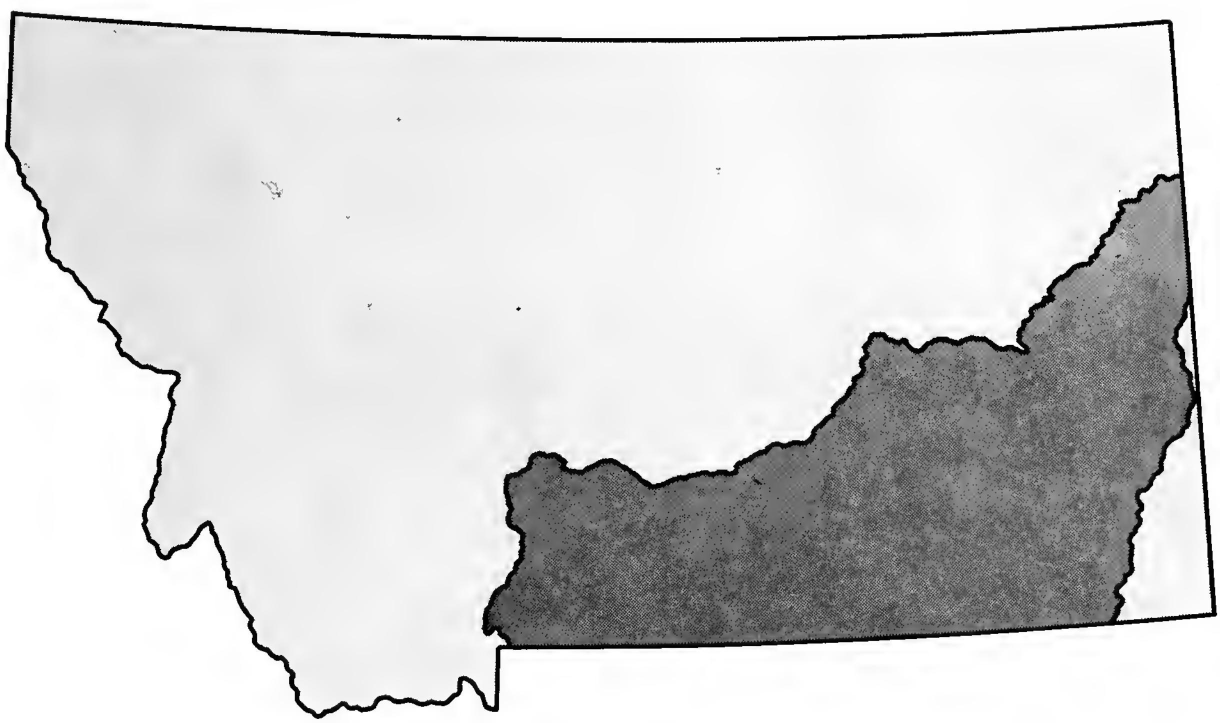
YELLOWSTONE RIVER BASIN

WATER RESOURCES SITUATION REPORT

1975



WATER RESOURCES DIVISION
MONTANA DEPARTMENT
OF NATURAL RESOURCES AND
CONSERVATION

YELLOWSTONE RIVER BASIN

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WATER RESOURCES DIVISION
MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

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Summary

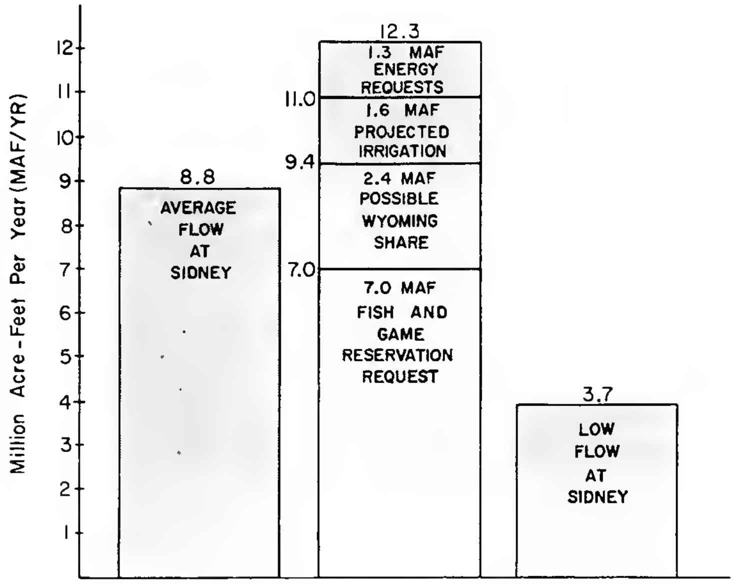
The Yellowstone River carries an average of 8.8 million acre-feet (MAF) of water out of Montana each year. Much of this water is available for use in Montana; however, exact quantification of the "surplus" water is difficult.

The Yellowstone River Compact divides the waters of the Bighorn, Tongue, Powder, and Clarks Fork Yellowstone Rivers between Wyoming and Montana. While Montana does not necessarily agree, Wyoming has estimated its share to be 2.4 MAF annually (1). The Crow and Northern Cheyenne Indian Tribes have undetermined legal claims to water for use on their reservations, and preliminary studies show they may consume about 1.0 MAF more than is presently being used by the year 2020 (2). Existing water rights throughout the entire basin must also be quantified before surplus water can be identified.

Identification of surplus water has become a critical issue because of possible future coal development and expanded irrigation. Energy-related companies have water filings, federal options, and applications that could deplete approximately 1.3 MAF of water each year, presumably for coal conversion facilities in Montana. Irrigated agriculture has increased by some 20,000 acres in the last two years, and expansion is expected to continue. Preliminary projections indicate that as many as 631,000 new acres of irrigated land may be in production by the year 2000, which could consume about an additional 1.6 MAF annually (3). Realizing that significant future stream depletions could irreversibly damage fish and wildlife resources of the basin, the Montana Department of Fish and Game recently requested a 7.0 MAF reservation at Sidney for instream flow protection.

Figure 1 depicts how possible future yearly requirements compare to the average annual flow and a low water year. Extreme variability in monthly and yearly flows of the Yellowstone River mainstem and tributaries can now cause water supply problems for water users in some areas. Obviously, not all forecasted needs can be met during an average water year.

FIGURE 1 — FLOW AT SIDNEY WITH POSSIBLE FUTURE WATER REQUIREMENTS BY THE YEAR 2000[1/]

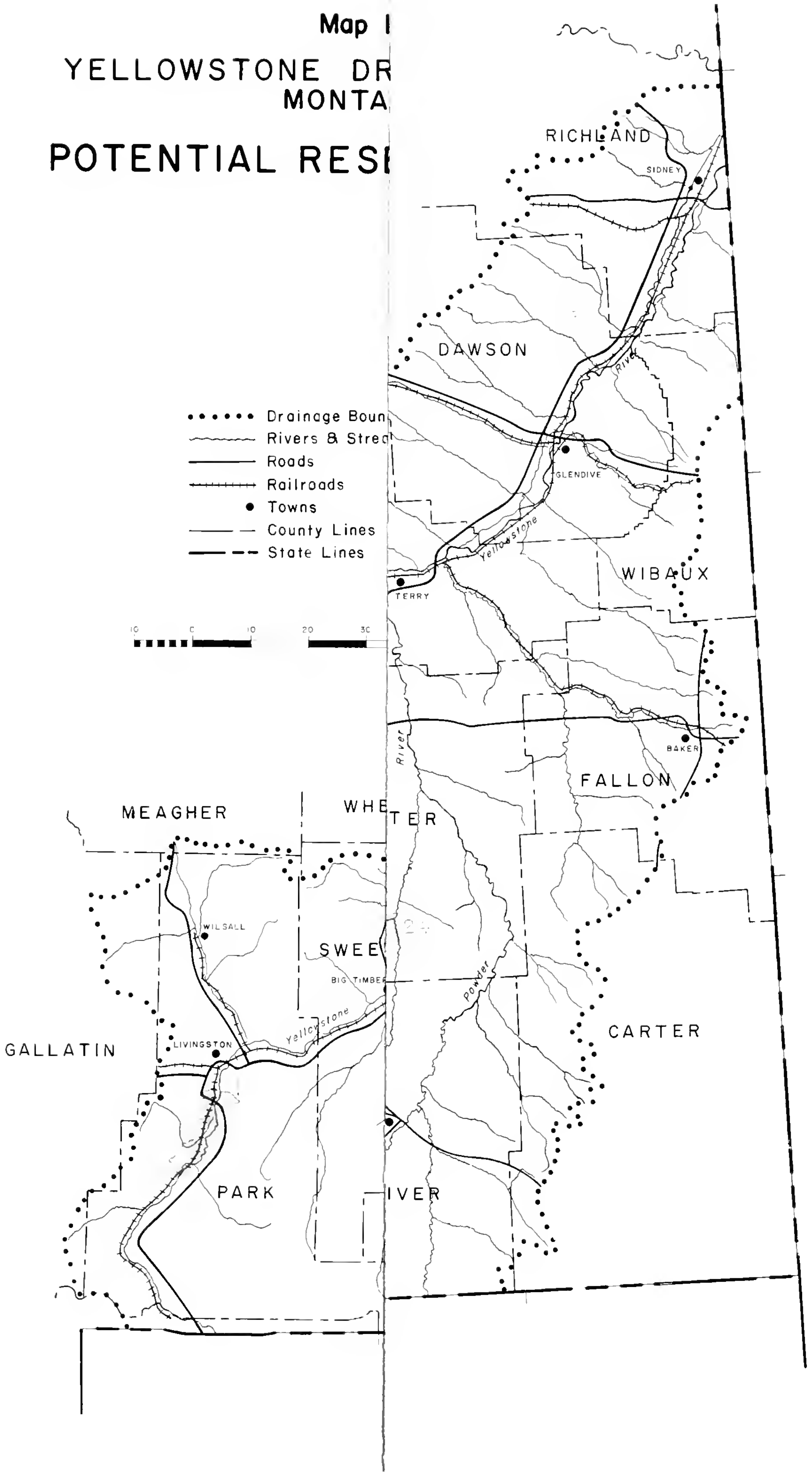


[1/] Possible water use on Indian Reservations is not shown separately since development (irrigation or energy) with that water is included in total basin projections.

Potential Reservoir Sites

New reservoirs could alleviate existing and future water supply problems in some areas, but they are not a total solution for the conflict over Yellowstone water. Construction of large reservoirs on the Yellowstone River could make available, for energy or irrigation use, about 2.0 MAF of water and still largely meet the instream flows recommended by the U.S. Fish and Wildlife Service, which total 4.35 MAF annually at Sidney (4). Map 1 shows some potential reservoir sites in the basin.

The Allenspur dam site alone could furnish 1.5 MAF of water annually and still provide a measure of fishery protection through releases for instream flows as recommended by the Fish and Wildlife Service. However, the reservoir would inundate 35 miles of "Blue Ribbon" trout stream and 37,000 acres of predominantly irrigated hay land. A Joint Resolution passed by the 1974 Montana Legislature declares that construction of this dam would be contrary to state goals and objectives.



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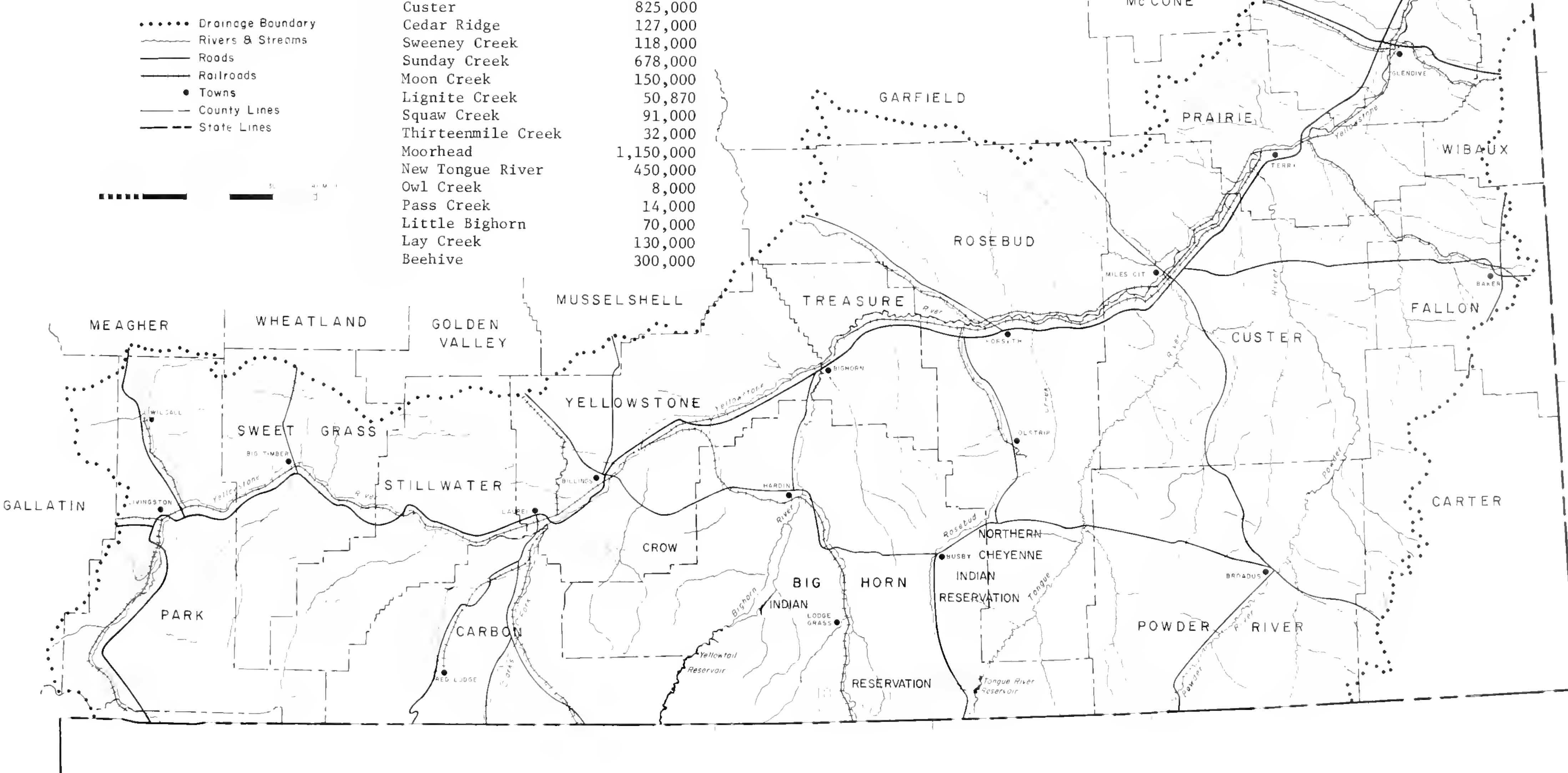
WILSALL
SWEE
BIG TIMBER
Powder
CARTER
GALLATIN
LIVINGSTON
Yellowstone
PARK
IVER

Map 1

YELLOWSTONE DRAINAGE BASIN MONTANA

POTENTIAL RESERVOIR SITES

Reservoir	Capacity (Acre-Feet)	Reservoir	Capacity (Acre-Feet)
Allenspur	4,000,000	Coal Creek	29,480
Pryor Creek	22,000	Pump Creek	48,440
Buffalo Creek	73,000	Pumpkin Creek	103,410
Lissa	2,180,000	Mizpah Creek	104,025
Tullock	270,000		
Custer	825,000		
Cedar Ridge	127,000		
Sweeney Creek	118,000		
Sunday Creek	678,000		
Moon Creek	150,000		
Lignite Creek	50,870		
Squaw Creek	91,000		
Thirteenmile Creek	32,000		
Moorhead	1,150,000		
New Tongue River	450,000		
Owl Creek	8,000		
Pass Creek	14,000		
Little Bighorn	70,000		
Lay Creek	130,000		
Beehive	300,000		



Ability to Pay

Water availability is not the only water resource problem in the basin. Industry is capable of paying a much higher price for a unit of water than are other potential users. Capital investment for supplying water to energy conversion plants is but a small percentage of the total facility cost, and as such presents little economic hardship. If necessary, several corporations could construct a combined water conveyance system with a relatively small financial burden. Thus, if the use of water were acquired on strictly a monetary basis, energy companies would be able to outbid both existing and potential irrigators, as well as other users, and conceivably preclude the expansion of irrigation in the Yellowstone Basin.

Although prices can be considered, they should not be the overriding concern. Of equal importance to this state are the private economic, environmental, and social opportunities that may be foregone due to industrial withdrawal of water.

State Water Planning Programs

Apportionment of the water resource, by limiting the amount supplied to each use so that all are afforded some measure of satisfaction, could solve water use problems. Montana potentially has the means to help resolve water use conflicts through the Water Use Act, the Water Moratorium Act, and the State Water Plan.

The 1973 Water Use Act gives the Board of Natural Resources and Conservation (BNRC) authority to reserve water for future beneficial uses on application by governmental agencies or political subdivisions of the state. The 1974 Water Moratorium Act suspends action on large (14,000 acre-feet per year, 20 cubic feet per second, or more) water use applications in the basin until March 1977. The moratorium calls for the reservation of water in order to preserve and protect both existing and future beneficial uses, and it emphasizes the need to reserve water for irrigation, municipalities, and fishery flows. However, neither act calls for thorough studies of the implications or interrelationships of such reservations.

The State Water Plan provides a vehicle by which the impacts of individual and cumulative reservations may be examined. First, the capability of the water resource to support various levels of development and preservation will be determined. Based on these water supply constraints, a set of alternative plans will be prepared. An in-depth public involvement program will then reveal which plan or plans are favored by Montanans.

This water planning process is being accomplished by a study team composed of representatives from state agencies. Cooperation is required since the impacts of water use relate to all phases of resource development and preservation. Including other agencies will strengthen the program by drawing

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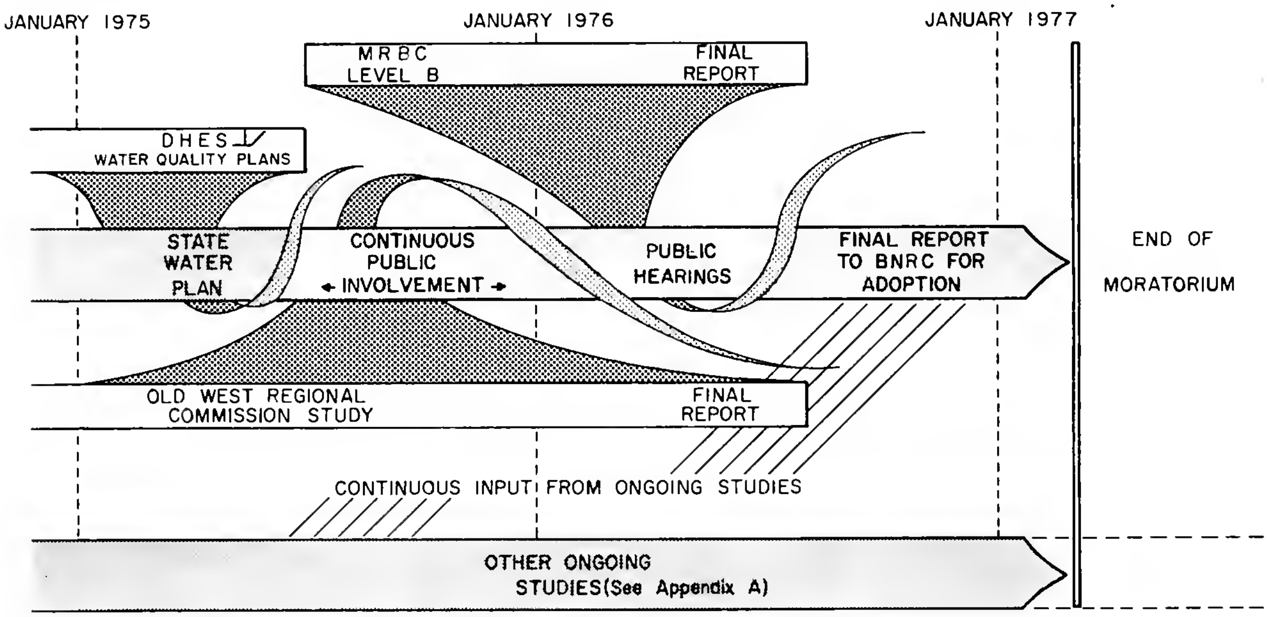
upon available expertise to provide a more viable recommended plan. The alternative plans presented to the public and the Board of Natural Resources and Conservation in 1977 may include recommended water reservations and other possible actions to alleviate water-related problems of the basin.

A significant contribution to this effort will come from a two-year study, funded by the Old West Regional Commission, designed to determine physical and biological impacts of water withdrawals on the middle and lower portions of the Yellowstone River and its tributaries. In addition, coordination with other studies will provide useful input.

The Missouri River Basin Commission (MRBC) has tentatively scheduled a Level B (reconnaissance) study of the Yellowstone Basin and adjacent coal areas to begin in 1975 and continue for one year. The objective of this study is to recommend a near-term plan for development, as well as for environmental preservation of the resources, that will be compatible with the long-range goals of the nation, the region, and the state. The Department of Natural Resources and Conservation (DNRC) will participate actively to ensure that Montana's interests are adequately represented.

Figure 2 shows time frames and the general sequence of these planning efforts.

FIGURE 2 - GENERALIZED SEQUENCE OF PLANNING EFFORTS IN THE YELLOWSTONE RIVER BASIN



1/ Montana Department of Health and Environmental Sciences

Conclusion

The Yellowstone River Basin does not have enough water to satisfy all existing uses, reservation requests, and projected demands. Montana has initiated and is participating in water planning programs to help resolve conflicts and provide for future conservation, protection, and wise use of the water resources of the basin in the best interests of the people of Montana.

Yellowstone River Basin Description

The Yellowstone River Basin includes much of north central Wyoming, southeastern Montana, and a small portion of western North Dakota. It is bounded by the Rocky Mountains on the west, the Missouri Basin on the north, the Little Missouri and Cheyenne Basins on the east, and the Platte Basin on the south. The total drainage area, having a length of about 440 miles and a maximum width of 320 miles, is 70,400 square miles. Wyoming contains 51% of the drainage basin; Montana, nearly 48%; and North Dakota, about 1%.

The extreme western region of the Yellowstone River Basin differs sharply from the eastern portion. The former is characterized by a succession of mountainous ranges and intervening valleys; the latter, primarily by gently rolling plains. Information presented in this report concerns the Montana portion of the basin.

Temperature

Frost free periods, or growing seasons, vary from a low of 40 days in Yellowstone Park to 135 days along the Yellowstone River. During the summer months, hot weather occurs frequently. In July, the warmest month, average temperatures range from 68.8° at Livingston to 75.0° at Miles City. In January, the coldest month, average temperatures range from 15.2° at Glendive to 27.1° at Big Timber.

Precipitation

Mean annual precipitation varies widely throughout the basin. Park County has the highest average annual precipitation rate, 24 inches, in Montana's portion of the basin. In the driest portion, adjacent to the Clarks Fork Yellowstone River in Carbon County, the average precipitation over a 16-year period is 6.59 inches. In the eastern portion of the basin, annual precipitation averages about 14 inches, nearly half of which falls during the growing season.

Annual snowfall varies from around 20 inches in the eastern plains to 300 inches in the mountainous areas. Most snow falls during the November-to-March period.

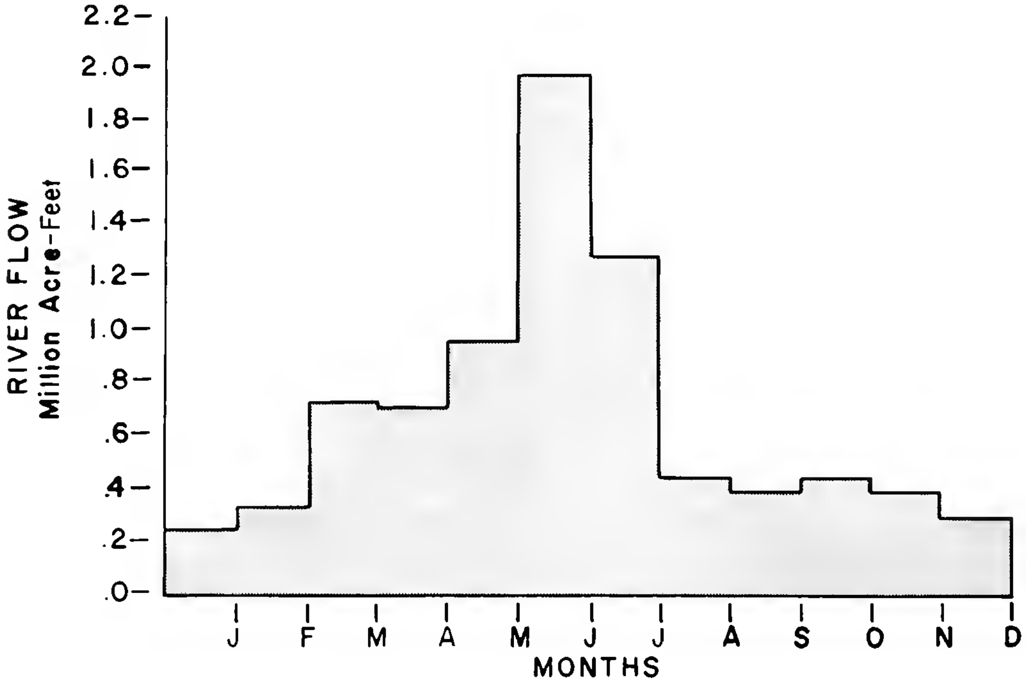
Water Resources

Surface Water

The primary source of water in the Yellowstone Basin is the snowpack that accumulates in the mountains during the winter. Surface runoff from

this snow normally begins in April and reaches a peak in late May or early June. The average monthly flows that occur during this time are 5 to 10 times the average flows that occur in fall and winter months. This runoff is essentially completed in late July, after which normal summer flows may be modified by diversions or summer rains. Figure 3 illustrates average monthly flows of the Yellowstone River at Sidney.

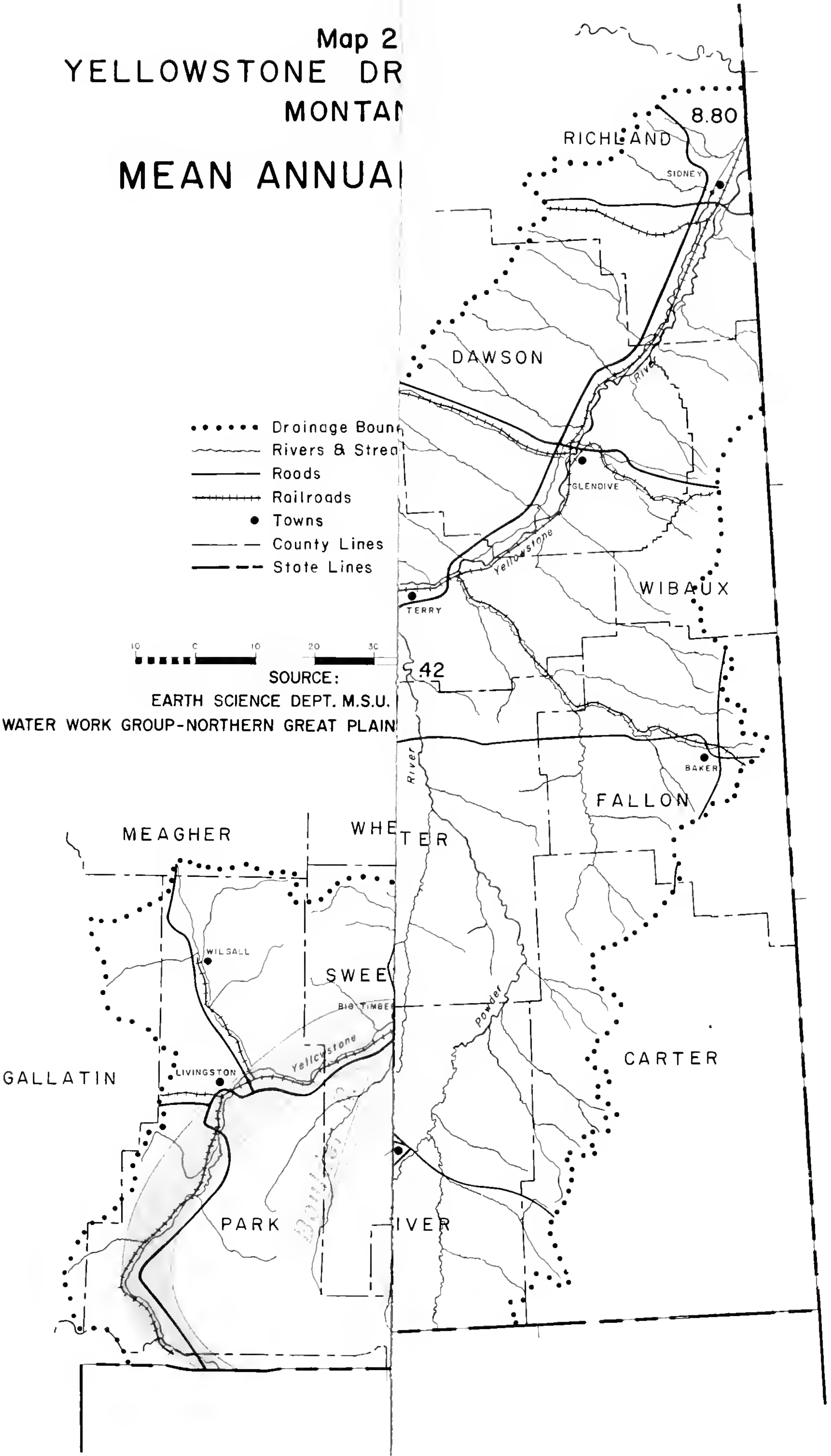
FIGURE 3—HYDROGRAPH OF THE YELLOWSTONE RIVER AT SIDNEY
1938—1970



The Yellowstone River originates in Wyoming and flows northeasterly through Montana. Over one-half of its total flow comes from the tributaries rising in the mountain ranges upstream from Billings. The Bighorn, Tongue, and Powder Rivers, originating in the Wyoming mountains, provide much of the remaining flow.

In the plains region, critically low flows, approaching no flows in some streams, occasionally occur in the fall, causing serious water use problems for irrigators and adversely affecting fish and wildlife habitats.

The average annual flow of the Yellowstone River at Sidney is 8.8 MAF. Approximately 33% of the total flow originates within Montana. Map 2 shows average runoffs of the Yellowstone River and its tributaries.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WATER WORK GROUP-NORTHERN GREAT PLAIN
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RICHLAND
SIDNEY
DAWSON
River
GLENDIVE
Yellowstone
WIBAUX
TERRY
42
River
BAKER
FALLON
MEAGHER
WHEATER
WILSALL
SWEE
BIG TIMBER
Powder
CARTER
GALLATIN
LIVINGSTON
Yellowstone
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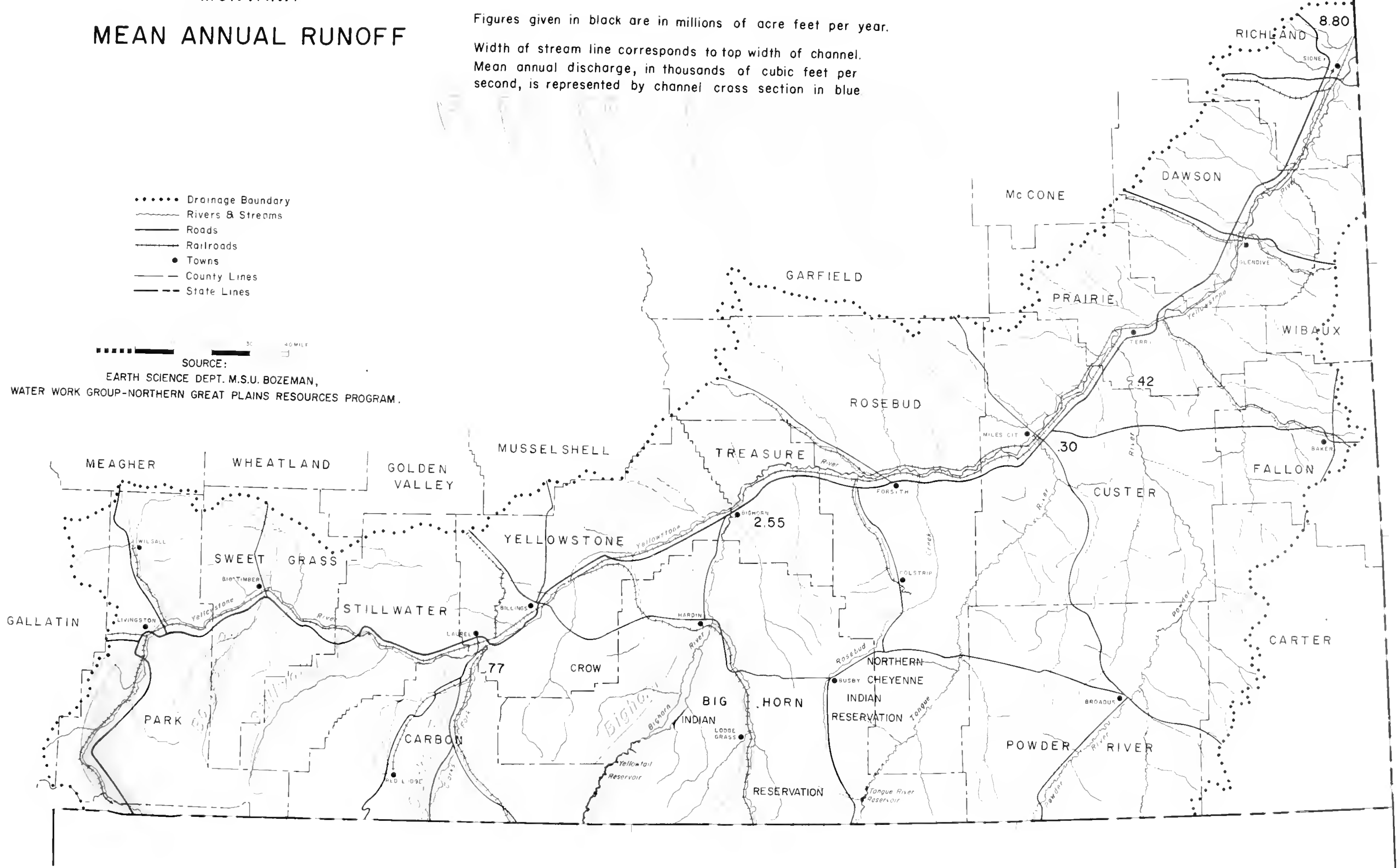
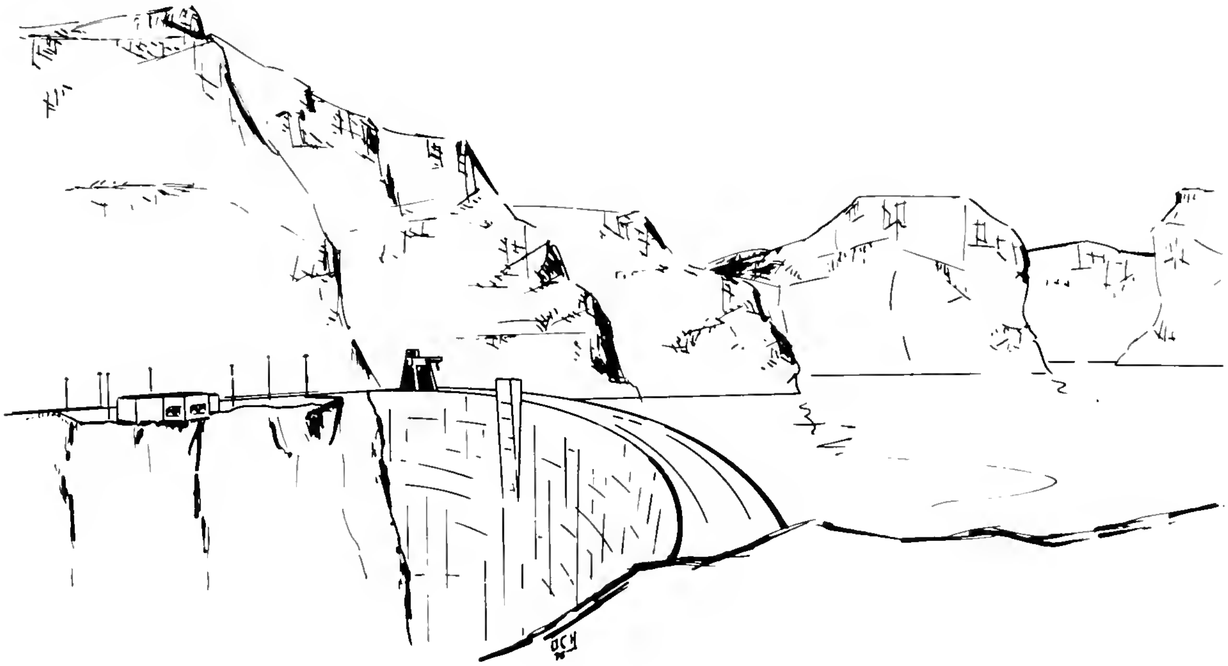
Map 2
YELLOWSTONE DRAINAGE BASIN
MONTANA
MEAN ANNUAL RUNOFF



Existing Reservoirs

Each of seven reservoirs has a total capacity of 5,000 acre-feet or more. Yellowtail Reservoir, with a capacity of 1,275,000 acre-feet, is the largest in the basin and accounts for 89% of the storage total of all seven. These seven reservoirs provide over 1.5 MAF of water storage for agricultural, municipal, industrial, and flood control purposes.



Surface Water Quality

The water of the Yellowstone River is generally of high quality, degrading somewhat from the upper to the lower reaches. Under authority of the Montana Water Pollution Act of 1955, the Department of Health and Environmental Sciences has classified the water of the Yellowstone River from the Yellowstone Park boundary to the Laurel water supply intake as:

> ...suitable for drinking, culinary and food processing purposes after adequate treatment equal to coagulation, sedimentation, filtration, disinfection and any additional treatment necessary to remove naturally present impurities; bathing, swimming and recreation; agricultural and industrial water supply; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers.

From the Laurel water supply intake to the Billings water supply intake, the Yellowstone River is degraded somewhat. The water, although still suitable for the uses described above, is fit only for "...marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers" (Emphasis added). Further degradation occurs through the lower reach of the Yellowstone River, from the Billings water supply intake to the Montana-North Dakota state line. Although appropriate for the uses described concerning the

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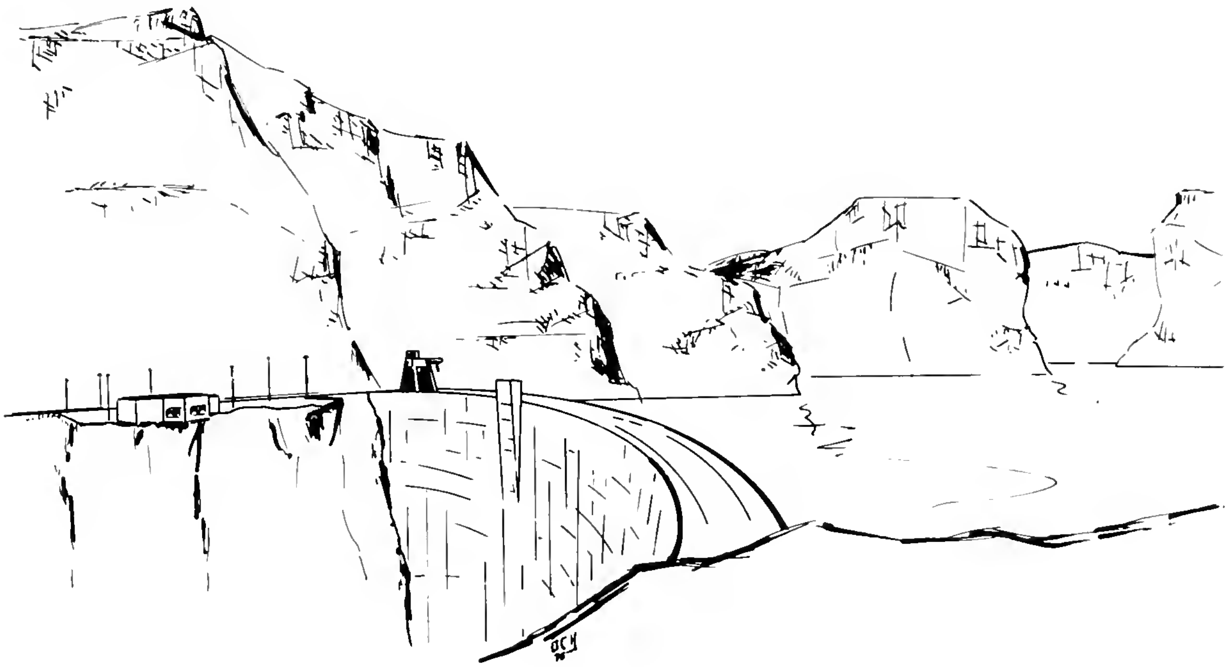

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two upstream reaches, the water will support only the propagation of "...non-salmonid fishes and associated aquatic life, waterfowl and furbearers."

Table 1 generally indicates concentrations of total dissolved solids (TDS) in surface water of the Yellowstone Basin. TDS is one indicator of the suitability of water for uses such as livestock, irrigation, and domestic.

TABLE 1. WATER QUALITY CLASSIFICATION - 1973 1/

Stream & Location	TDS (Parts Per Million)	Use: Livestock	Use: Irrigation	Use: Domestic
Yellowstone River				
Miles City	394	good	good	satisfactory
Sidney	460	good	good	satisfactory
Powder River				
Moorhead	615	good	fair	unsatisfactory
Tongue River				
Miles City	560	good	fair	unsatisfactory
Bighorn River				
Bighorn	608	good	fair	unsatisfactory
St. Xavier	622	good	fair	unsatisfactory

1/ Department of Health and Environmental Sciences, Montana Water Pollution Control Plan, June 27, 1973.

Ground Water

Ground-water aquifers are scattered throughout the Yellowstone Basin. Shallow aquifers line the Yellowstone River and its tributaries, while the Madison Limestone Group underlies much of the area. Coal beds form aquifers in some portions of the basin. Quantity and quality of the ground-water resource are extremely variable, as shown in Table 2.

TABLE 2. AQUIFER CHARACTERISTICS 1/

Aquifer	Depth (Feet)	Yield (Gallons Per Minute)	TDS (Parts Per Million)
Shallow	To 300	5 - 1,500	600 - 6,000
Madison Group	1,000 - 8,000	2 - 3,700	1,000 - 300,000

1/ Bureau of Reclamation, Eastern Montana Basins Report, August, 1972.

Present and Possible Future Water Uses

Irrigated Agriculture

Present

Rainfall during the growing season, particularly in the eastern portion of the basin, rarely exceeds 10 inches. Since water requirements for grass and alfalfa are normally about 25 inches over the entire growing season, irrigation of many crops is necessary. Presently irrigated lands total about 630,000 acres, consuming annually an estimated 1.5 MAF of basin water.

Many irrigators now experience drainage and salinity problems. Sprinkler irrigation presents a partial solution and is being used, not only on new lands, but to sprinkle fields previously irrigated by gravity methods. Irrigation efficiency can be increased 15% to 30% by sprinkler application of water.

Contributing to irrigation problems are the water distribution networks in the basin, which typically deteriorate with age. Many canals and ditches are causing permanently wetted areas, growth of phreatophytes, and erosion and siltation where wasteways and cross drainage structures are not adequately protected and maintained. Technical soils, economics, and water management services would assist farmers in their endeavor to better utilize water for irrigation.

Future

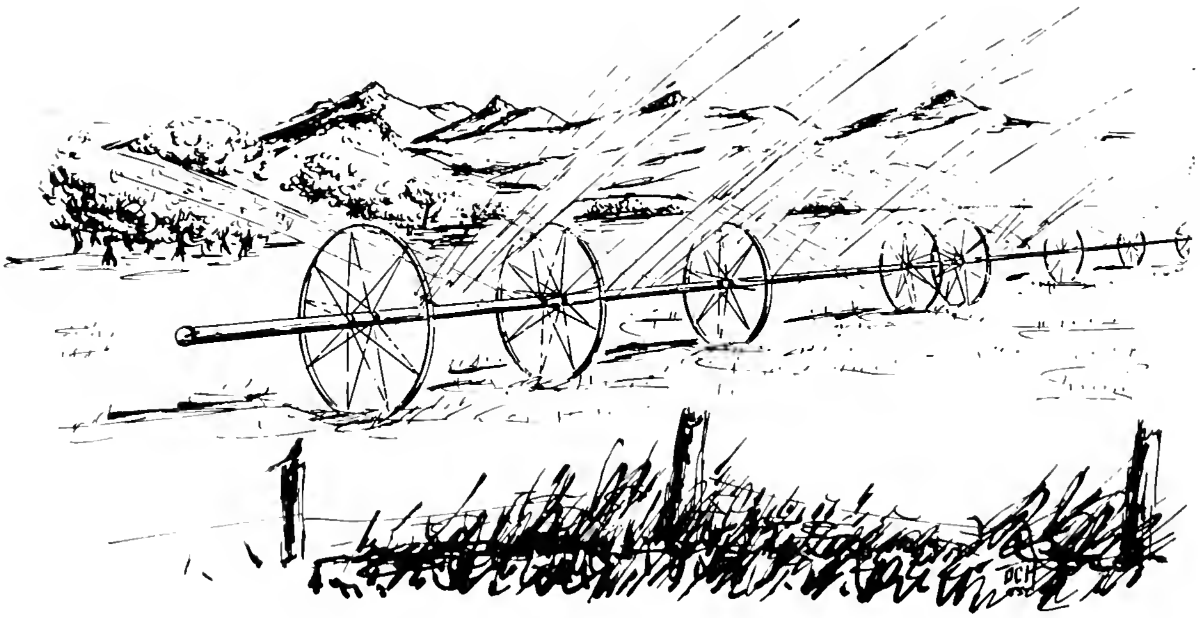
Present expansion of irrigation in the basin is occurring primarily with sprinklers, with pump lifts varying from a few feet to 450 feet above the Yellowstone River. Sprinkler irrigation has expanded to include about 20,000 new acres within the last two years, and expansion is expected to accelerate with an estimated 40,000 more acres over the next two years.

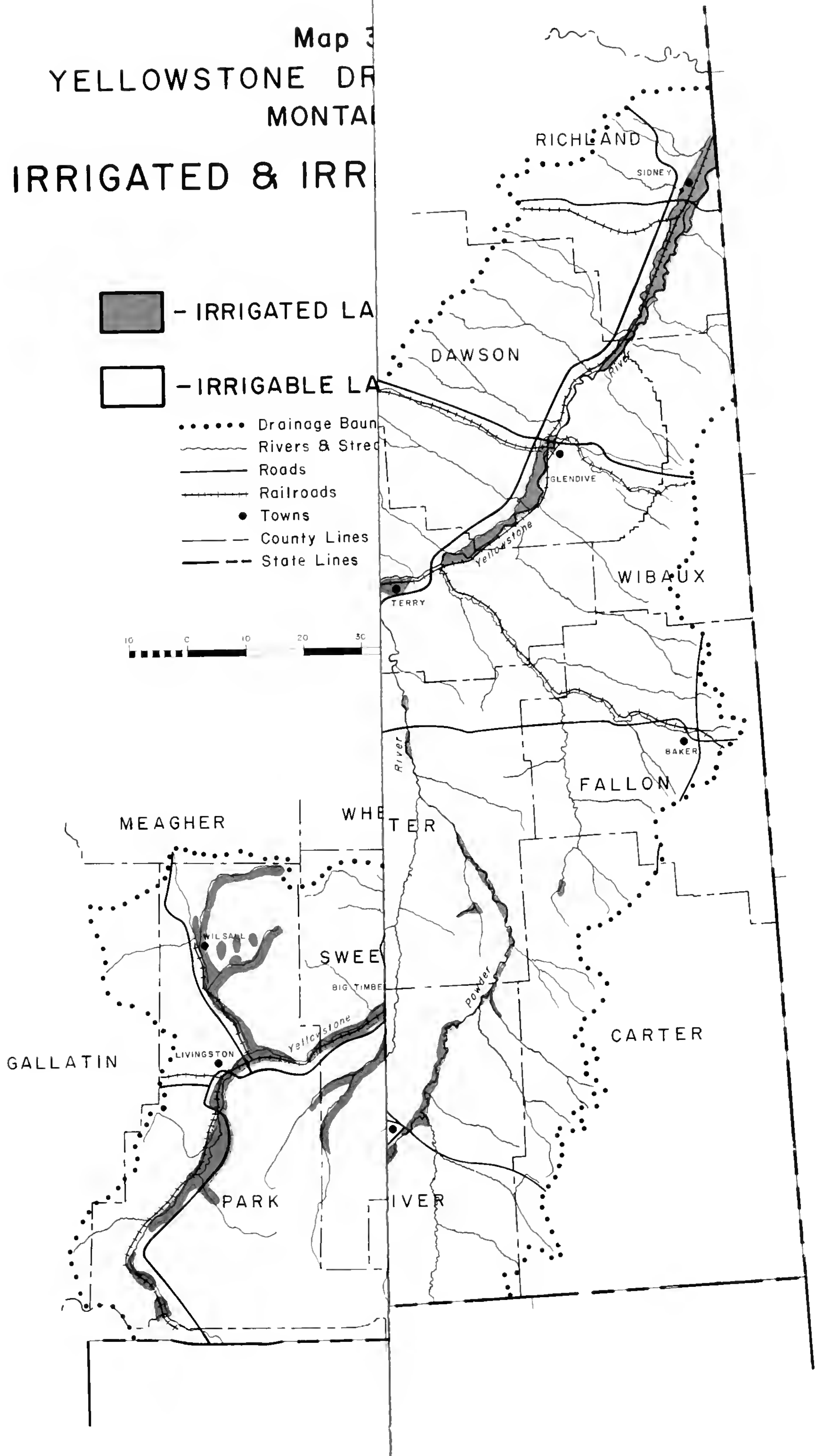
Long range projections of irrigation growth or decline are estimates at best. Most irrigated agricultural products are used in beef production, which is highly variable. The future of irrigation depends, therefore, on more than availability of our land and water resources. General economic conditions, federal import and export policies, and world eating habits will be influential.

Projections for increased red meat production vary from 1.5 to 2.73 times present capacity through the year 2020 (3). To sustain this possible growth, existing rangeland must be protected and irrigated lands expanded. Based on red meat projections, the DNRC has projected the need for 630,500 new irrigated acres by the year 2000. These new lands would consume about 1.6 MAF each year.

The determination of the Yellowstone River Basin's capacity to support increased crop production includes an inventory of land and water, taking into account soils, topography, drainage, water supply, and climatic characteristics. Land classification surveys by the DNRC are specifically designed to establish the degree of suitability of land for sustained irrigated agriculture. This land classification separates areas having potential for irrigation from "nonirrigable" lands, but disregards water supply and economic conditions. A reconnaissance survey indicates about 2,200,000 acres of land are capable of producing crops if adequate water supplies were made available. A large percentage of this land will probably never be irrigated because of technical or economic limitations of water delivery systems. Map 3 shows presently irrigated and potentially irrigable lands of the basin.

The DNRC is conducting studies to determine the feasibility of delivering water to irrigable lands in the Yellowstone River Basin. The first phase concerned lands within five miles of a potential water source, assuming 700 feet as the maximum pump lift. While results of this effort are preliminary, it appears that the land resource is no constraint to future development. Further studies will consider 1) cropping patterns and associated water requirements, 2) technical and economic feasibility of water delivery systems, and 3) available water supplies. Resource and economic evaluations will be made to provide an estimation of the most probable level of irrigation development.





Map 3
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Yellowstone
PARK
IVER

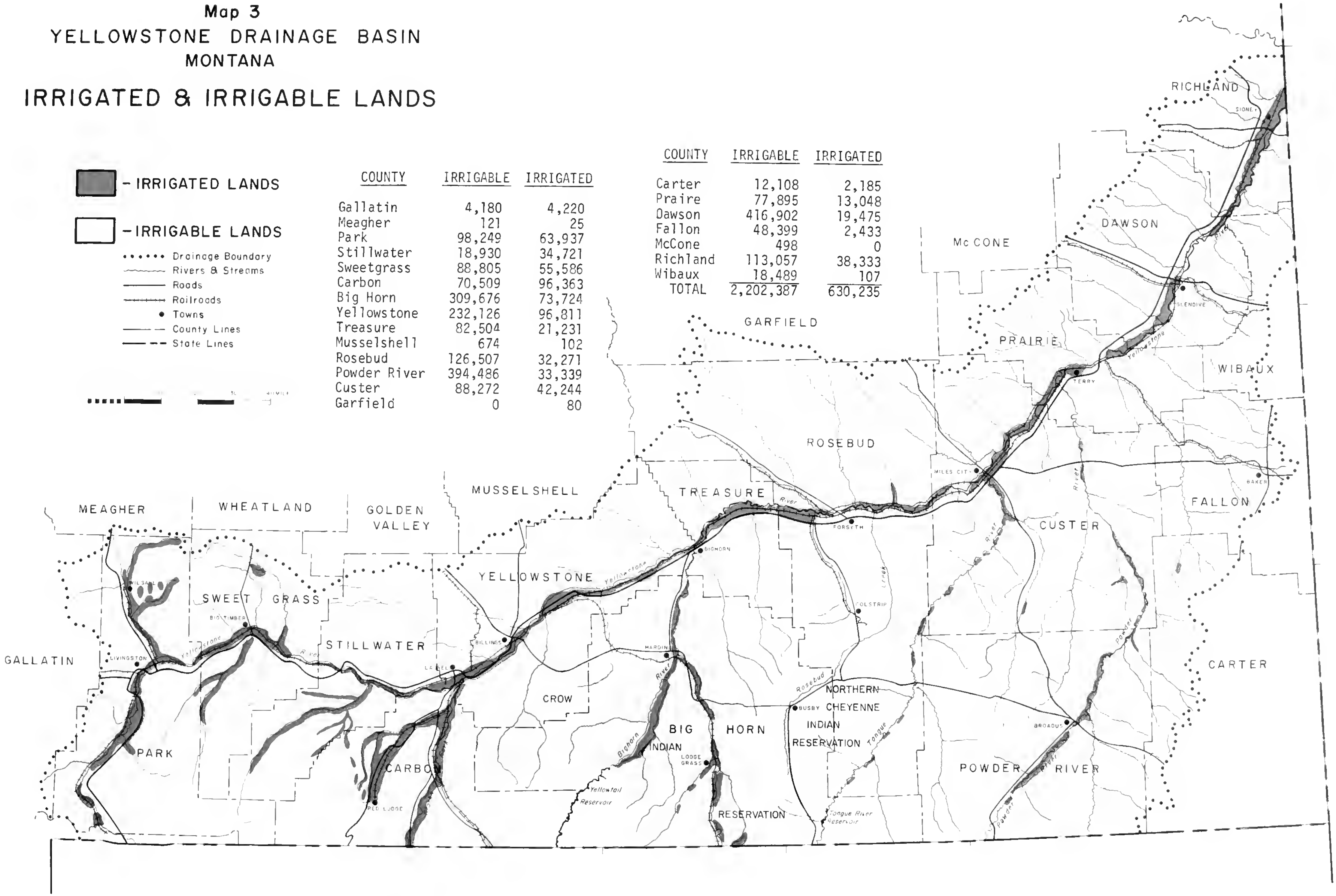
Map 3

YELLOWSTONE DRAINAGE BASIN
MONTANA

IRRIGATED & IRRIGABLE LANDS

COUNTY	IRRIGABLE	IRRIGATED
Gallatin	4,180	4,220
Meagher	121	25
Park	98,249	63,937
Stillwater	18,930	34,721
Sweetgrass	88,805	55,586
Carbon	70,509	96,363
Big Horn	309,676	73,724
Yellowstone	232,126	96,811
Treasure	82,504	21,231
Musselshell	674	102
Rosebud	126,507	32,271
Powder River	394,486	33,339
Custer	88,272	42,244
Garfield	0	80

COUNTY	IRRIGABLE	IRRIGATED
Carter	12,108	2,185
Praire	77,895	13,048
Dawson	416,902	19,475
Fallon	48,399	2,433
McCone	498	0
Richland	113,057	38,333
Wibaux	18,489	107
TOTAL	2,202,387	630,235



Energy

Present

The amount of water diverted for oil, coal, and gas production is relatively minor, being less than 10,000 acre-feet per year. Not all is actually consumed. About 90,000 acre-feet of water is used to cool thermoelectric plants that generate 329 megawatts (MW) of electricity. Practically all of this water is withdrawn for once-through cooling, with most returning to the Yellowstone River.

The Yellowtail and Mystic Lake hydroelectric generating plants produce 260 MW of power. While water used for hydroelectric generation is not consumed, reservoirs must be kept at certain levels for turbines to operate at maximum capacity, which affects water availability for downstream users. Water is consumed through evaporation from reservoirs; however, it is extremely difficult to apportion these losses on a multipurpose project.

Future

Increased energy demands and the federal government's "Project Independence" programs have focused national attention on the coal and water resources of the Yellowstone River Basin, and the potential for energy development in the area is enormous. Latest estimates list over 43 billion tons of coal in the Montana portion of the Fort Union formation as economically recoverable under current strip mine technology (5). Map 4 shows the location of coal reserves in the basin.

It is probably impossible to accurately forecast the numbers and types of major energy development facilities that may occur in this state. However, attempts have been made by both public and private groups to estimate future levels of energy production. The wide discrepancies in these estimates result from a lack of data on industries' plans and the uncertainty of federal policy.

The Northern Great Plains Resource Program (NGPRP)1/ has made projections for coal development in the Northern Great Plains area. These coal development profiles (CDP's) do not represent plans for development, but were designed to provide a means to measure the effects of differing levels of development. Table 3 lists these CDP's and associated water requirements, which vary from a low of 24,455 acre-feet per year to 549,745 acre-feet per year.

1/ The NGPRP is a joint effort by state and federal government, industry, environmental groups, and concerned individuals designed to provide information and analysis on effects of coal development. The study area encompasses the Northern Great Plains area of Montana, Wyoming, North and South Dakota, and Nebraska.

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The Yellowtail and Mystic Lake hydroelectric generating plants produce 260 MW of power. While water used for hydroelectric generation is not consumed, reservoirs must be kept at certain levels for turbines to operate at maximum capacity, which affects water availability for downstream users. Water is consumed through evaporation from reservoirs; however, it is extremely difficult to apportion these losses on a multipurpose project.

Future

Increased energy demands and the federal government's "Project Independence" programs have focused national attention on the coal and water resources of the Yellowstone River Basin, and the potential for energy development in the area is enormous. Latest estimates list over 43 billion tons of coal in the Montana portion of the Fort Union formation as economically recoverable under current strip mine technology (5). Map 4 shows the location of coal reserves in the basin.

It is probably impossible to accurately forecast the numbers and types of major energy development facilities that may occur in this state. However, attempts have been made by both public and private groups to estimate future levels of energy production. The wide discrepancies in these estimates result from a lack of data on industries' plans and the uncertainty of federal policy.

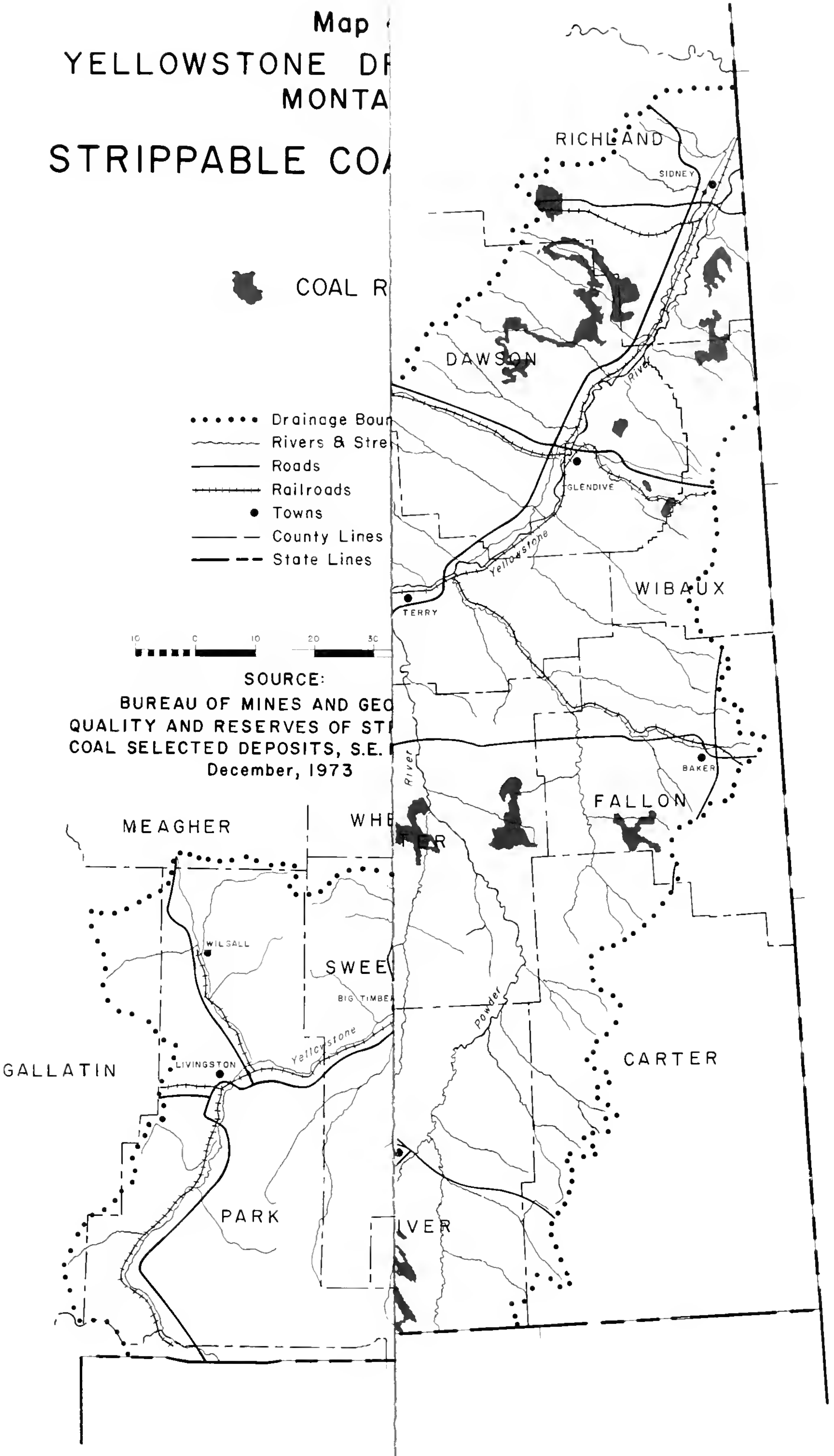
The Northern Great Plains Resource Program (NGPRP)1/ has made projections for coal development in the Northern Great Plains area. These coal development profiles (CDP's) do not represent plans for development, but were designed to provide a means to measure the effects of differing levels of development. Table 3 lists these CDP's and associated water requirements, which vary from a low of 24,455 acre-feet per year to 549,745 acre-feet per year.

1/ The NGPRP is a joint effort by state and federal government, industry, environmental groups, and concerned individuals designed to provide information and analysis on effects of coal development. The study area encompasses the Northern Great Plains area of Montana, Wyoming, North and South Dakota, and Nebraska.

TABLE 3. NGPRP COAL DEVELOPMENT PROFILES AND WATER USE DATA - YEAR 2000

	Conversion Facilities Data			Population Data		Coal Production and Revegetation Data			Total
Coal Development Profiles	Megawatts (MW)	Synthetic Natural Gas (No. of Plants4/)	Water Use (Acre-Feet Per Year)	Population Increase5/	Water Use (Acre-Feet Per Year6/)	Coal Production (M.S.T./yr7/)	Area Requiring Water(Acres8/)	Water Use (Acre-Feet Per Year9/)	Total Water Use (Acre-Feet Per Year)
CDP I									
Low Water Use1/	3,075	0	15,375	34,000	7,750	58	2,000	1,330	24,455
Conservation Water Use2/	3,075	0	36,900	34,000	7,750	58	2,000	1,330	45,980
High Water Use3/	3,075	0	58,425	34,000	7,750	58	2,000	1,330	67,505
CDP II									
Low Water Use	3,075	6	51,375	64,000	14,350	133	4,600	3,000	68,725
Conservation Water Use	3,075	6	93,900	64,000	14,350	133	4,600	3,000	111,250
High Water Use	3,075	6	238,425	64,000	14,350	133	4,600	3,000	255,725
CDP III									
Low Water Use	3,075	15	105,375	144,000	32,250	393	13,600	9,070	146,695
Conservation Water Use	3,075	15	179,400	144,000	32,250	393	13,600	9,070	220,720
High Water Use	3,075	15	508,425	144,000	32,250	393	13,600	9,070	549,745

1/ Assumes 6,000 Acre-Feet/yr for SNG plant and 5,000 Acre-Feet/yr (dry cooling) per 1,000 MW generated.
2/ Assumes 9,500 Acre-Feet/yr for SNG plant and 12,000 Acre-Feet/yr per 1,000 MW.
3/ Assumes 30,000 Acre-Feet/yr for SNG plant and 19,000 Acre-Feet/yr per 1,000 MW.
4/ SNG - 250 million standard cubic feet per day.
5/ Current population is 125,000 in principal impact area (Miles City and Billings).
6/ 200 gallons per day per person.
7/ M.S.T.: 1,000,000 Short Tons (2,000 lbs.).
8/ Assumes: - 1,730 tons of coal per acre.
- 95% recovery (1,644 tons per acre)
- average 35 foot seam in SE Montana.
9/ Assumes: - Water requirement of 12 inches per season.
- Drought years would furnish 4 inches per season.



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BIG TIMBE
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GALLATIN
CARTER
PARK
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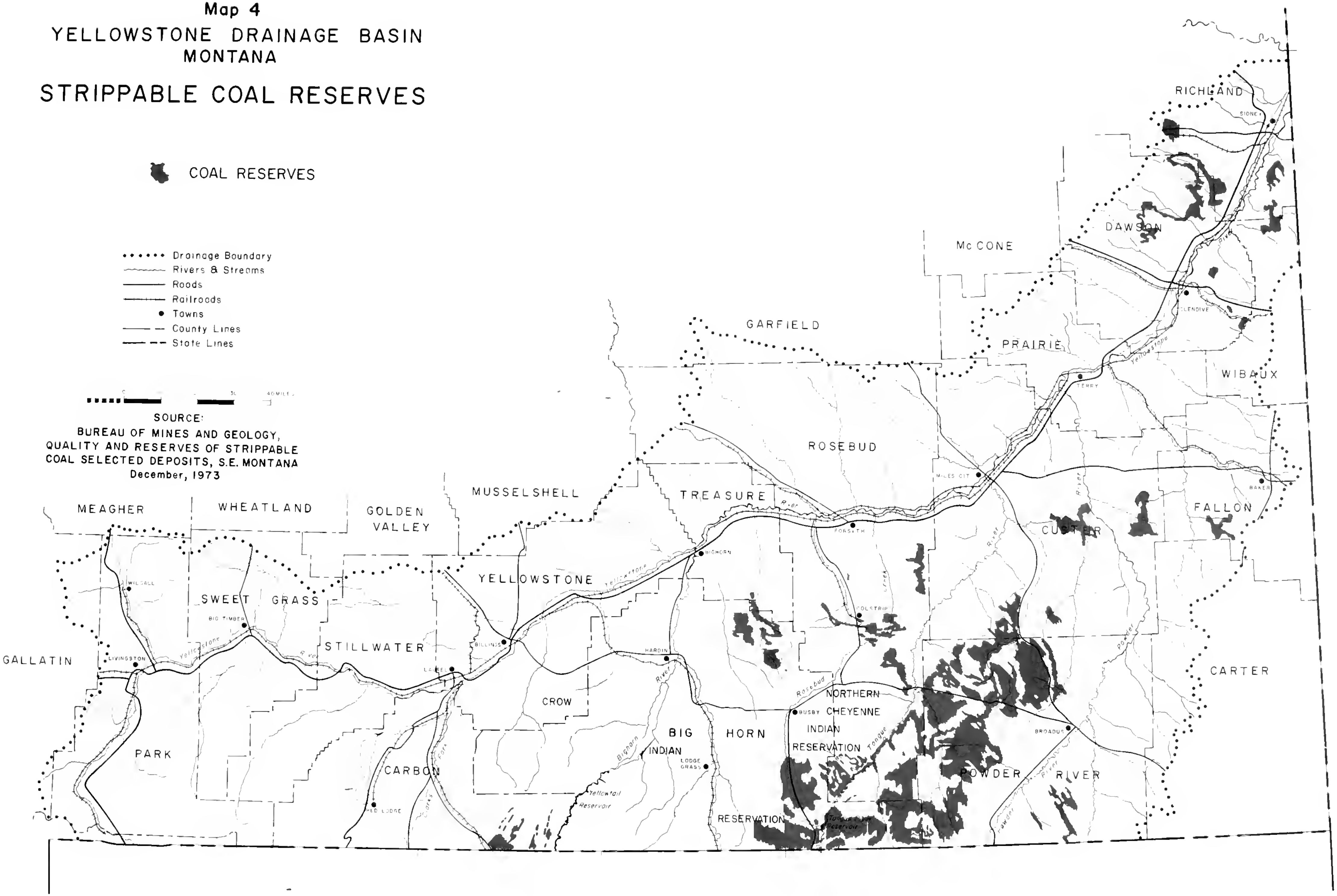
Map 4
YELLOWSTONE DRAINAGE BASIN MONTANA
STRIPPABLE COAL RESERVES



Industrial Water Rights

Table 4 presents industrial water rights applications, filings, and federal options for use in Montana, and Map 5 shows their locations (with the exception of those for Yellowtail Reservoir).

TABLE 4. INDUSTRIAL WATER, YELLOWSTONE RIVER BASIN, MONTANA, 1974

(ACRE-FEET PER YEAR)

	Filings Prior to the Water Use Act (Amounts Are Subject to Final Adjudication)		Federal Options for Use in Montana		Applications Submitted Under the Water Use Act		Total by River Basin
Yellowstone River Main Stem	Montana Power	144,795			Getty Oil	92,000	643,240
	Montana Power	144,795					
	Montana Power	181,000					
	Intake Water Co.	80,650					
Tongue River Basin	Basin Electric	36,200			Montana Water Storage	170,000	333,400
					Water Reserve Company	127,200	(168,400)1/
Bighorn River Basin (Yellowtail Reservoir)			Gulf Oil	50,000			
			Exxon Oil	50,000			
			Peabody Coal	80,000			
			Shell Oil	48,000			
			Westmoreland	30,000			258,000
Powder River Basin					Intake Water Company	318,700	391,100
					Utah International	72,400	(129,000)1/
Yellowstone River Basin-Unspecified					Gulf Mineral Res. Co.	90,000	90,000
TOTAL							1,715,740 (1,288,640)1/

1/ Figures as modified by the DNRC to reflect water availability

A modification of this table is necessary to present a more realistic set of figures for industrial water rights applications. This table indicates a total of 724,500 acre-feet applied for by energy companies in the Powder and Tongue River Basins, which exceeds the amount of water available. Studies have estimated that 168,400 acre-feet are available in the Tongue (1,6) and 129,000 acre-feet in the Powder River Basin (4). If the filings in these two basins are reduced to reflect the actual amount of water available, then the basin-wide total becomes 1,288,640 acre-feet, or 427,100 acre-feet less than has been applied for.

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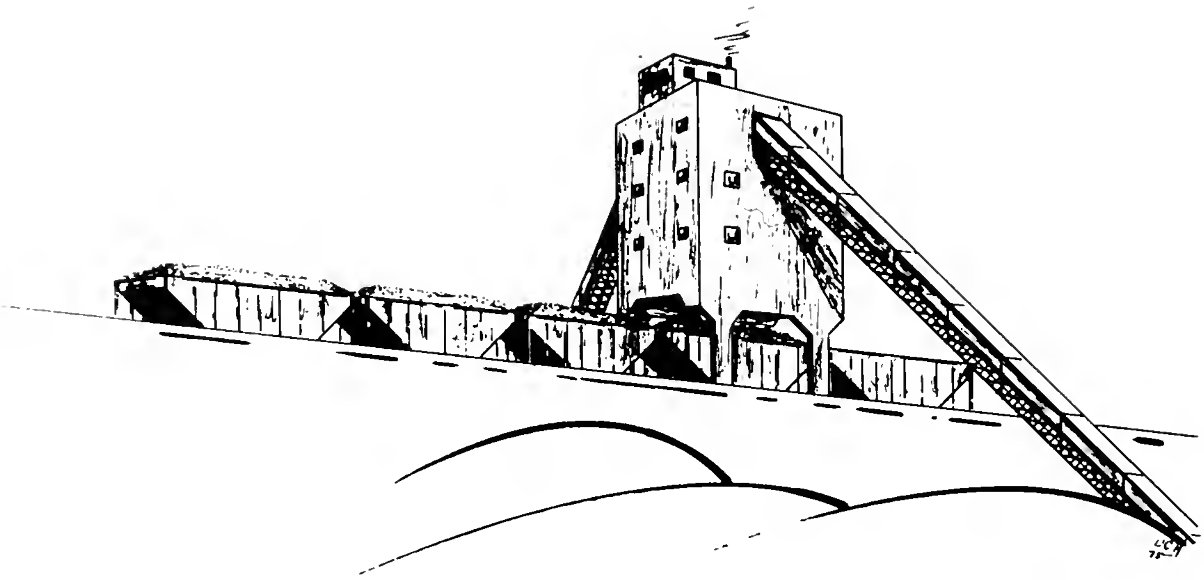
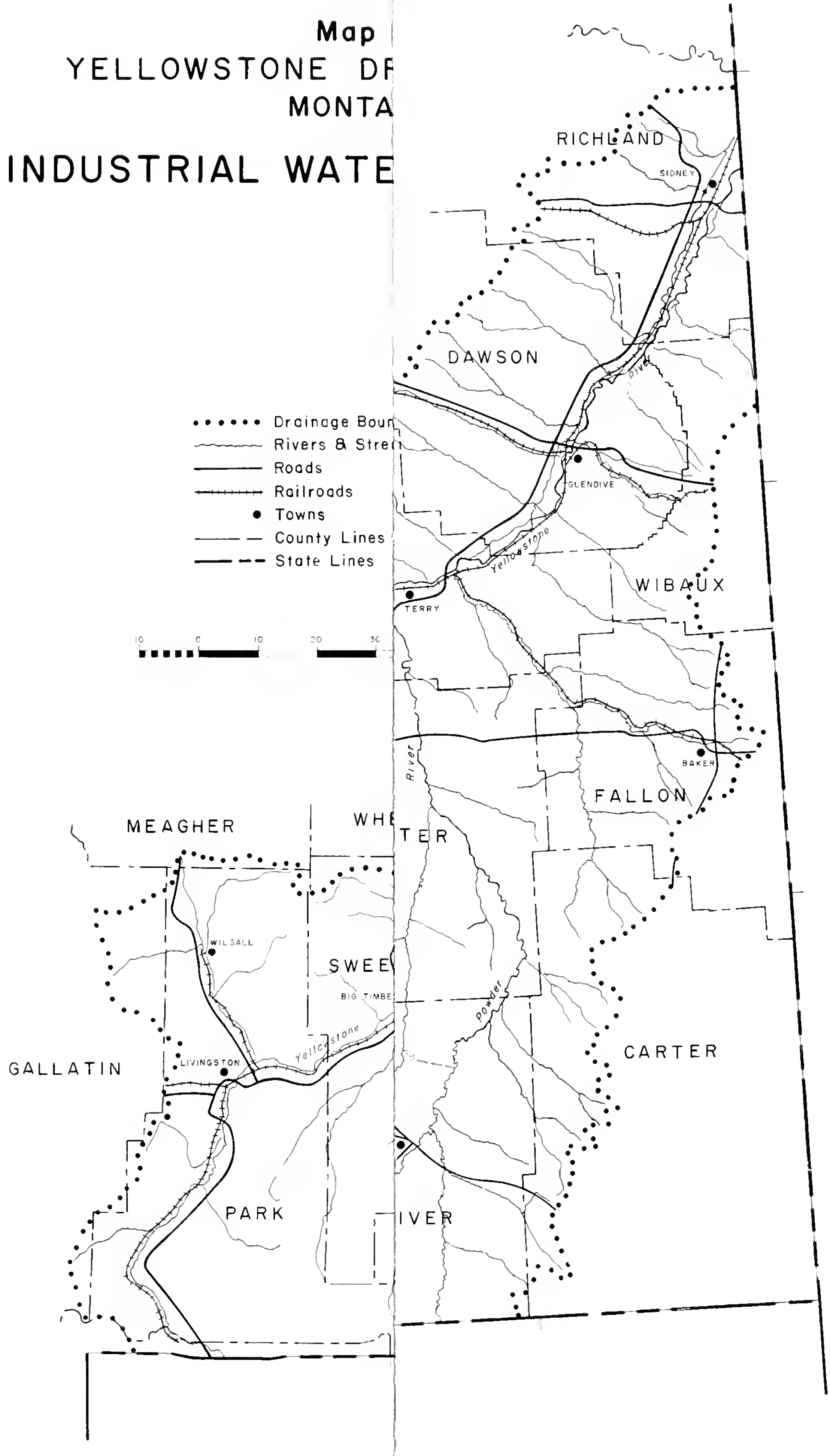


Attempting to measure the energy industries' interest in developing coal and water resources of the Yellowstone Basin, the Department sent a questionnaire to over 100 energy-related companies and received a 34% response. Nine companies indicated plans to develop the area's water resources, and 28 stated that they had no plans to do so. Table 5 summarizes the returns.

TABLE 5. SUMMARY OF INDUSTRIAL QUESTIONNAIRE RESPONSE THROUGH 1990

Conversion Process	Number of Facilities	Size	Diversion Requirement (Acre-Feet/Year)
Electric Generation	4	2100 MW	38,000
Electric Generation or Gasification	1	1500 MW or 375 mmcf/d1/	17,000/25,000
Gasification	4	1000 mmcf/d	68,000
Gasification/ Liquefaction	6	1500 mmcf/d	96,000
		TOTAL	219,000/227,000

1/ million cubic feet of gas per day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DAWSON
GLENDIVE
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TERRY
WIBAUX
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FALLON
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WILSALL
SWEE
BIG TIMBE
Powder
Yellowstone
LIVINGSTON
GALLATIN
CARTER
PARK
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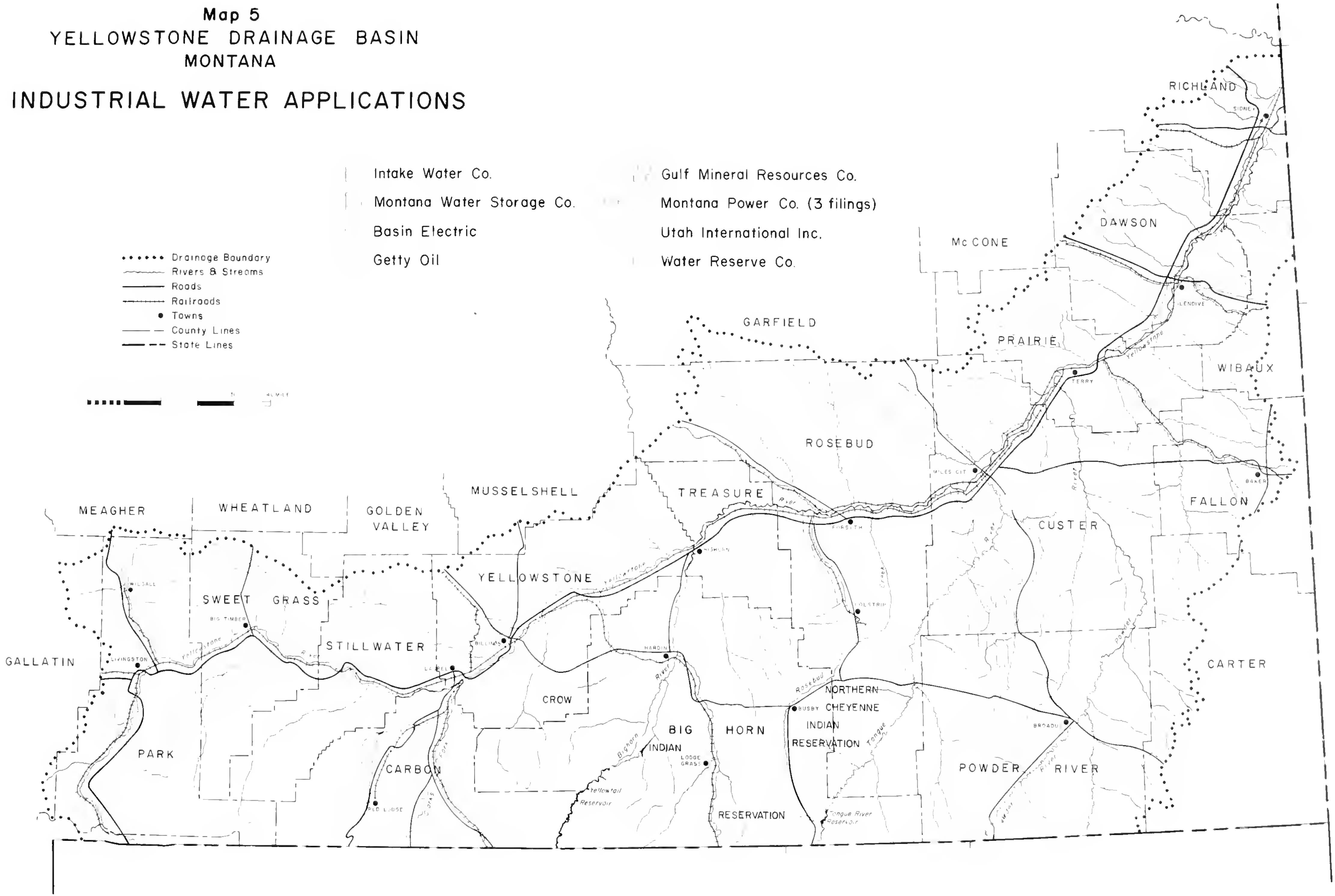
Map 5
YELLOWSTONE DRAINAGE BASIN
MONTANA

INDUSTRIAL WATER APPLICATIONS



Other Energy Related Considerations

Among the elements that should be examined when undertaking a study of potential energy developments and their impacts are those of coal slurry pipelines, aqueducts, and dry cooling systems.

Coal Slurry Pipelines — Coal slurry pipelines are a method by which a coal and water mixture can be shipped from the mine to the area of conversion. Table 6 compares water requirements for conversion within the state with those for shipping the coal to a different area for conversion purposes. It should be noted that under present law the use of water for slurry to export coal from Montana is not a beneficial use.

TABLE 6. WATER REQUIREMENTS FOR SOME ENERGY CONVERSION AND CONVEYANCE FACILITIES1/

Energy Source	Consumptive Water Requirements/Million BTU'S
Steam Electric - Nuclear	24.0 - 240.0 gallons
Steam Electric - Coal	24.0 - 161.9 gallons
Coal Gasification	95.9 - 161.9 gallons
Coal Slurry Pipeline	0 - 13.2 gallons

1/ Western States Water Council, Western States Water Requirements for Energy Development to 1990, November 1974.

According to the Water Work Group of the Northern Great Plains Resource Program, 600 to 800 acre-feet of water is required to move 1 million tons of coal by coal slurry pipelines (4). A 1,000 megawatt electric generation plant requires about 4 million tons of coal per year. Conversion would require about 15,000 acre-feet of water each year. Exporting the same amount of coal via a pipeline would require from 2,400 to 3,200 acre-feet annually.

Aqueducts — Many coal beds are from 20 to 200 miles from significant surface water resources. Thus, for coal conversion, water must be delivered to the coal site, or the coal shipped to the water source. One means of transporting water

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to Montana's coal fields for use in the conversion process is by aqueduct. The Bureau of Reclamation made reconnaissance level aqueduct studies from 1967 to 1971. The Northern Great Plains Resource Program has estimated the cost of water delivered through aqueducts to vary from about $25 to $370 per acre-foot, depending on the distance the water is conveyed (4). The Bureau has proposed further aqueduct studies, but Montana will not endorse such an effort until the consequences of energy development are thoroughly evaluated and state decisions are made regarding the desired amount and type of future development.

Dry Cooling — Water, essential in all energy development facilities, is used primarily for cooling in the coal conversion process. As shown in Table 7, wet cooling systems consume large amounts of water, while dry cooling techniques are the most water conservative of the alternatives.

TABLE 7. WATER REQUIREMENTS FOR STEAM ELECTRIC COAL FIRED GENERATING PLANTS 1/

Cooling System	Depletion
Evaporative Cooling	15,000 acre-feet/year/1,000 MW unit
Pond	10,000 " " "
Once Through	3,600 " " "
Dry Cooling	2,000 " " "

1/ Western States Water Council, Western States Water Requirements for Energy Development to 1990, November 1974.

While dry cooling facilities use less water than other cooling methods, they are also the most expensive. However, recent studies have indicated that, if the cost of water goes above the range of $40 to $130 per acre-foot, dry cooling techniques become economically feasible (7). In the economic analysis used to derive this range, water delivery costs to supply wet cooling towers did not include foregone opportunities for irrigation, municipal water supply, recreation, pollution dilution, and instream values.

Recreation and Wildlife

Recreation

The Fish and Game Commission has established 230 miles of the Yellowstone River (from Gardiner to Pompey's Pillar) as an outstanding stream under its recreational waterway system.

The Bureau of Outdoor Recreation is in the process of completing a 5(d) study on the Yellowstone River (from Gardiner to Pompey's Pillar) to determine if its physical setting meets standards for inclusion within the Federal Wild and Scenic River system. If the results of this study, which will be published in early March, meet the physical criteria, then an additional implementation study, including public involvement as well as a management program, is required before a final recommendation on inclusion is made.

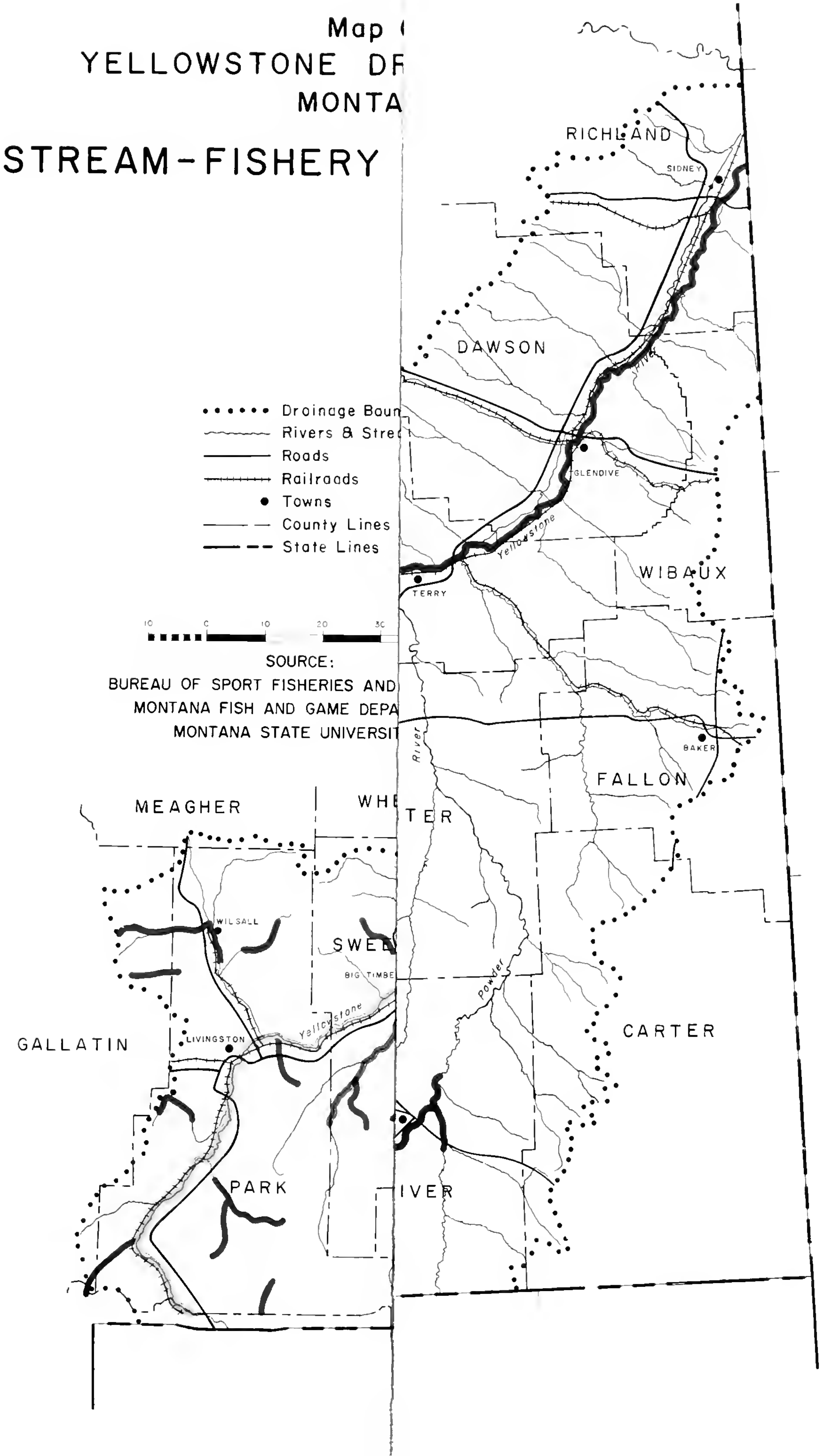
Fish and Wildlife

The waters of the Yellowstone Basin support world-renowned trout fishing in the upper reaches and a large variety and quantity of warmwater game and nongame fish in the lower reaches. The river system also supports Canada geese, ducks, bald eagles, and great blue herons. Antelope and mule and white-tail deer are found along the river bottoms, while elk, moose, and bear are established closer to Yellowstone National Park. The river system also supports a great number of nongame species.

The Yellowstone is one of the few large, free-flowing rivers left in the United States. The Fish and Game Commission has classified streams according to their importance. Class 1 streams are "blue-ribbon" streams of national importance, Class 2 streams are of state significance, and Class 3 streams are of regional value. Criteria for classification include 1) accessibility, 2) aesthetics, 3) use, and 4) productivity. As Table 8 and Map 6 illustrate, there are about 500 miles of Class 1, 2, and 3 streams in the basin. Class 4 streams, of local significance, are also shown on Map 6.

TABLE 8. STREAM-FISHERY CLASSIFICATION

Significance	Reach	Miles	
1. National	Yellowstone River		
	Park Boundary to Big Timber	95	
	TOTAL		95
2. State	Yellowstone River		
	Big Timber to Columbus	70	
	Upper Boulder River	35	
	Upper Stillwater River	45	
	TOTAL		150
3. Regional	Yellowstone River		
	Columbus to Laurel	25	
	Lower Boulder River	40	
	West Fork of the Stillwater River	15	
	Lower Stillwater River	25	
	Slough Creek	15	
	West Fork Rosebud Creek	30	
	Rosebud Creek	35	
	Bighorn River	25	
	Lodgegrass River	35	
	Little Bighorn River	30	
	TOTAL		275
	GRAND TOTAL		520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SOURCE:
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MONTANA FISH AND GAME DEPA
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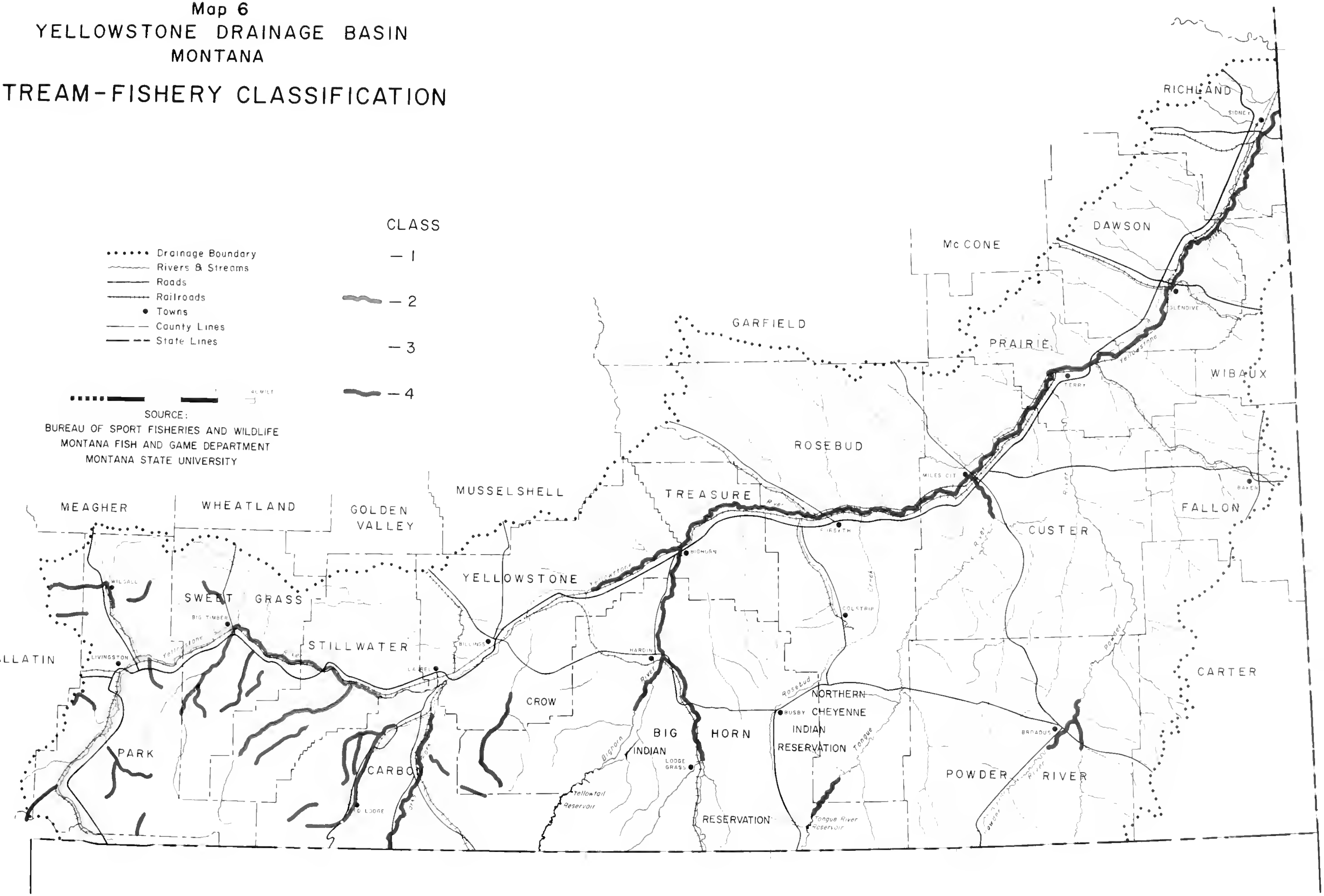
WILSALL
SWEE
BIG TIMBE
Powder
GALLATIN
LIVINGSTON
Yellowstone
CARTER
PARK
IVER

Map 6
YELLOWSTONE DRAINAGE BASIN
MONTANA

STREAM-FISHERY CLASSIFICATION



Reservation Request

Under the authority of the 1973 Water Use Act, the Department of Fish and Game has submitted a request for reservation of flows in the Yellowstone River, and additional requests will be submitted concerning major tributaries. The Board of Natural Resources and Conservation has not acted on this request at this time. The following table shows the instream flow reservation request for the Yellowstone River from the mouth of the Clarks Forks Yellowstone to the Montana-North Dakota state line.

TABLE 9. DEPARTMENT OF FISH AND GAME FLOW RESERVATION REQUEST, YELLOWSTONE RIVER

(ACRE-FEET)

Month	Mouth of Clarks Fork Yellowstone River to Mouth of Bighorn River	Mouth of Bighorn River to Mouth of Powder River	Mouth of Powder River to State Line
January	135,274	245,954	276,705
February	122,183	222,152	205,470
March	159,870	387,378	461,175
April	178,515	374,881	446,325
May 1-20	249,921	383,212	416,535
May 21-31	250,913	370,915	436,370
June	1,207,951	1,785,150	2,023,340
July 1-20	479,015	708,110	833,020
July 21-31	130,911	200,730	218,200
August	233,656	332,038	368,940
September	178,515	321,327	327,305
October	184,466	368,931	368,940
November	178,515	357,030	357,060
December	135,274	245,954	276,705
TOTAL	3,824,979	6,303,762	7,016,090

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Water Rights

The actual amount of water available for development or to provide instream flows is a complex matter. Five major water rights issues defy positive quantification at this time:

Existing Water Rights

Indian Water Rights

Federal Water Rights

Existing Water Rights Litigation

Yellowstone River Compact

Existing Water Rights

The Montana Water Use Act of 1973 provides a permit system for the appropriation and use of surface and ground water, procedures for the determination and court adjudication of water rights existing prior to the effective date of the Act (July 1, 1973), and the establishment of a centralized record system of all water rights.

Because of Montana's lack of documentation concerning valid water use, water supply problems described earlier, and implications of industrial applications, it was decided that the initial determination of existing water rights would be within the Yellowstone River Basin. Field work to determine validity of water right declarations in the Powder River Basin will be done in the summers of 1975 and 1976, and the statutory adjudication of the other three interstate tributaries (Tongue, Bighorn, and Clarks Fork Yellowstone) will be completed next, followed by adjudication of the main stem of the Yellowstone River.

Until the adjudication process is completed, quantification of water rights is not possible. One method to estimate existing water rights would be to assume that all valid water rights are indicated in water supply records. That is, if the appropriator were actually putting water to use, the depletion would be reflected in gaging station records downstream. However, under Montana law, an appropriator could divert water for a number of years, abandon the system, submit a declaration for a water right, and possibly receive a valid right. Consequently, water rights might not be adequately reflected in historical records, and numerous such cases would violate the accuracy of that method.

Indian Water Rights

Present recognition of Indian "reserved" water rights began with the United States Supreme Court's decision in the Winters case in 1908. The Winters Doctrine, as it has been developed over the years, holds that when the various Indian tribes ceded their lands to the United States, reserving smaller tracts for their own use, they also reserved sufficient water to fulfill their needs on the reservation. The "reserved" right may apply to all waters arising on or flowing by or through a reservation. The measure of the reserved right is in dispute, although some courts have measured the right according to the irrigable acreage on the reservation. The reserved right does not depend upon actual use, and is therefore available for future as well as present needs. Thus, even if the quantity of the reserved right is determined, the question arises as to whether that water can be put to uses (such as coal-based industrialization) which were not contemplated when the reservation was created.

While it is clear that there are questions remaining to be answered concerning Indian reserved rights, the basic theory and existence of those rights are firmly established. Since major tributaries of the Yellowstone flow by or through both the Crow and Northern Cheyenne Reservations, the Indians' reserved rights will affect other water uses. It is possible that Indian reserved rights can be quantified in Montana state courts with the United States acting as trustee of the tribes. If so, much of the uncertainty which currently surrounds Indian reserved rights would be removed.

TABLE 10. ESTIMATED INDIAN WATER REQUIREMENTS BY THE YEAR 2020[1/]

(ACRE-FEET PER YEAR)

	Crow Reservation	Northern Cheyenne Reservation
Agriculture	1,080,000[2/] (540,000)	109,200 (54,600)
Wildlife	823,300 (0)	178,800 (0)
Energy	196,500 (196,500)	196,500 (196,500)
Industrial	7,000 (1,540)	300 (0)
Domestic	1,800 (400)	1,400 (300)
Recreation	500 (110)	300 (60)
TOTALS	2,114,100 (738,550)	486,500 (251,570)

1/ U.S. Department of the Interior, Report on Water for Energy in the Northern Great Plains Area with Emphasis on the Yellowstone River Basin, October 1974.

2/ First number represents water diverted or used instream, while the figure in parentheses indicates the amount of water consumed.

Federal Water Rights

Reserved rights attach, not only to Indian lands, but to any lands the United States has withdrawn from the public domain for federal purposes. Upon withdrawing the lands, the United States withdrew or reserved sufficient water to satisfy the federal purposes. Included in this category are most Forest Service lands, national parks, recreation areas, and wildlife refuges. The same problems of quantification seen with Indian rights apply to these Federal reserved rights. It is clear, however, that Federal reserved rights can be quantified in State courts.

Existing Water Rights Litigation

The most important pending litigation concerning water rights in the Yellowstone River Basin revolves around Intake Water Co., Inc., a wholly-owned subsidiary of Tenneco, Inc., of Houston, Texas. The basis of the three separate actions to which Intake is a party is its claim of an existing right to divert 111.4 cubic feet of water per second from the Yellowstone River at a point near Intake, Montana. Intake claims to have perfected its appropriation for sale, rent, and distribution for irrigation, industrial, municipal, and domestic purposes under the "old law" as it existed in Montana prior to July 1, 1973 (Sections 89-810 through 89-812, R.C.M. 1947). In pleadings, Intake has revealed its general intent to sell water to "companies with energy generating or conversion plants within or outside the State of Montana," including its parent corporation, Tenneco, Inc.

Intake instituted the first of the three actions, suing the Yellowstone River Compact Commission in Federal District Court. Intake seeks a declaratory judgment that the Yellowstone River Compact is unconstitutional in that it requires, under Article X, unanimous consent of the three signatory states before any water can be diverted from the Yellowstone River Basin. Intake also asks a ruling declaring unconstitutional the Montana statute (Section 89-846, R.C.M. 1947) requiring legislative consent before water can be diverted out of the state.

In the second action, in state district court, Intake wants a declaratory ruling that its planned diversion of Yellowstone water for industrial purposes is not subject to the Montana Utility Siting Act (Section 70-801 _et seq._, R.C.M. 1947).

The third action was instituted in state court against Intake by the Department of Natural Resources and Conservation, asking a declaratory ruling that Intake failed to comply with Montana law as it existed prior to July 1, 1973, in perfecting its alleged water appropriation right from the Yellowstone River. A ruling is sought that Intake must therefore comply with the permit requirements of the Montana Water Use Act (Section 89-865 _et seq._, R.C.M. 1947) prior to taking any water from the Yellowstone River.

All three cases are currently pending, so none of the questions they raise have been resolved. The outcome of this litigation is important, however, not only because of the size of Intake's alleged appropriation right, but also because there are several other corporations with similar large claims for Yellowstone Basin water for industrial purposes. Thus, final judgment will likely determine the validity of these other claimed rights from the Yellowstone, and whether the claimants must comply with the Montana Water Use Act.

Yellowstone River Compact

The Yellowstone River Compact, executed by Montana, Wyoming, and North Dakota, and ratified by the United States Congress in 1950, was designed to allocate water of the Clarks Fork Yellowstone, Bighorn, Tongue, and Powder Rivers. The compact recognizes water rights prior to 1950, those rights designated to supplement land irrigated prior to 1950, and water rights for irrigation projects started before 1950. The compact divides the remaining water as follows:

TABLE 11. DIVISION OF WATERS UNDER THE YELLOWSTONE RIVER COMPACT

Tributary	Wyoming	Montana
Clarks Fork Yellowstone	60%	40%
Bighorn	80%	20%
Tongue	40%	60%
Powder	42%	58%

Article X of the compact prohibits diversion of water out of the Yellowstone Basin without the unanimous consent of the signatory states. This Article has recently become controversial, because Wyoming would like to divert water out of the basin for energy conversion. Montana's position at this time is to withhold approval of such diversions until the two states can agree on quantification of the percentages of tributary flows. Wyoming has published its estimates of these quantities, as presented in Table 12. Montana does not necessarily agree and intends to independently calculate its compact share.

TABLE 12. WYOMING'S YELLOWSTONE COMPACT ESTIMATES (ACRE-FEET)

Clarks Fork Yellowstone	429,000	285,000
Bighorn	1,800,000	400,000
Tongue	96,400	144,700
Powder	120,700	166,600
TOTAL	2,446,100	996,300

Conclusion

This report has presented an overview of the existing and possible future demands on the water resources of the Yellowstone River Basin. While water use projections are not commitments, they do illustrate possible future depletions, and there is not enough water in the basin to completely satisfy all possible water users.

Compromises must therefore be accomplished, which can be aided by development of a water plan. Many factors not covered in this report, such as social and economic conditions, must be considered before recommendations can be formulated.

A status report on this planning effort will be published in 1976, and in 1977 this Department will present a comprehensive guide for the protection and conservation of the Yellowstone River Basin's water resources. This guide, which will include water use recommendations, will be based on projected needs and problems, resource capabilities, social factors, economic and environmental considerations, and public input.

Literature Citations

1) Wyoming State Engineer's Office, The Wyoming Framework Water Plan, May 1973.

2) U.S. Department of the Interior, Report on Water For Energy in the Northern Great Plains Area with Emphasis on the Yellowstone River Basin, October 1974.

3) Montana Department of Natural Resources and Conservation, Preliminary Agriculture Projection, February 1975.

4) Northern Great Plains Resource Program, Water Work Group Report, December 1974.

5) Montana Bureau of Mines and Geology, Strippable Subbituminous Coal and Lignite of the Fort Union Coal Area in Eastern Montana, October 1971.

6) Montana Water Resources Board and Bechtel Corporation, Tongue River Report, Basic Design Report, 1969.

7) Montana State University, Water Resources Research Center, An Economic Analysis of Alternative Technologies for Colling Thermal-Electric Generating Plants in the Fort Union Region, Research Report 49, 1974.

Appendix A

Other Ongoing Studies

Montana Bureau of Mines and Geology, Ground-water Studies.

National Commission on Water Quality Study.

Northern Cheyenne Research Project.

Northern Great Plains Resource Program.

U.S. Department of Agriculture, Surface Environment and Mining Studies.

U.S. Department of the Interior, Bureau of Indian Affairs, Water Rights Study.

U.S. Department of the Interior, Bureau of Land Management and U.S. Forest Service, Decker-Birney Study.

U.S. Department of the Interior, Bureau of Land Management and U.S. Geological Survey, Surface Water and Ground-water Studies.

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